“Some Thoughts on Real Estate Pricing”

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Some Thoughts on Real Estate Pricing: Agenda

► Context:
  ▪ “Bubble” pricing?
  ▪ Past bubbles
  ▪ Greenspan’s definition of a bubble

► The Spread between Interest Rates and Cap Rates:
  ▪ Historical perspective – including inflation’s role
  ▪ Interest rates v. cash-flow yields
  ▪ Tilting your portfolio: bonds v. real estate
  ▪ Impacts of shifting capitalization rates

► How Real Estate Ought to be Priced:
  ▪ What do I want v. How will it be generated?
  ▪ TIPS market v. real-return requirements
  ▪ Current capitalization rates v. history

► Addendum: Forward (Interest & Inflation) Rates
Is CRE in “Bubble” Territory?

• How should we view the level of CRE prices?

Green Street Property Sector Indices

Property sector indices are indexed to 100 at their ‘07 peaks.

Source: Green Street Advisors, Commercial Property Price Index, October 10, 2017.
“Bubbles” ← Easy to Spot, After They Bust

• Finance has a long history of asset bubbles, dating as far back as at least:
  – 1637: Dutch tulip mania
  – 1711: British South Sea bubble
  – 1763: Mississippi Land Company
  – ...

• But, of course, bubbles are easily spotted after they burst!

• Before they burst, there are simply disagreements about the likely path of future prices.

• This is the essence of any debate about current prices:
  ➢ Have prices strayed too far from some sense of “fundamental” value?
The Debate About Asset Prices

- In finance (real estate or otherwise), the debate about asset prices generally falls into three possible explanations:

1. **“This time is different”** – there has been a shift in some underlying structural factor(s) [e.g., globalization, legislation, socio-economic, political, etc.].

2. **“Noise”** – simply some random fluctuations (with the mistaken impression of trend).

3. **“Animal spirits”** – a pattern, driven by excessive optimism (a “bubble”) or pessimism, which is about to reverse itself.
More Recent Examples ← Where Were You?

• Let’s recall three more-recent examples:
  – Late 1990s: San Francisco office rents
  – Mid 2000s: (U.S.) Home prices
  – Mid 2000s: (U.S.) Commercial real estate prices

• As you consider these examples, candidly ask yourself:
  → Did you recognize the bubble before it burst?

• If so, did you have the (financial) courage to act on it?

• Acting on the recognition of the bubble can take two forms:
  1. Avoidance of over-priced assets ← risk-averting strategy
  2. Exploit the over-priced assets ← risk-seeking strategy

It’s easy to consider yourself an expert, after the fact!

Using the correction to your advantage. As one example, consider the brilliance and the guts displayed in *The Big Short* in which certain hedge-fund managers:  
*a* recognized the bubble in home prices,  
*b* understood the exposure in the junior tranches of sub-prime debt and  
*c* invented credit-default swaps on these junior tranches. [CDS existed previously, but not on sub-prime debt.]
Greenspan’s Definition of a Bubble

“I define a bubble as protracted period of falling risk aversion that translates into falling capitalization rates that decline measurably below their long term trendless averages. Falling capitalization rates propel one or more asset prices to unsustainable levels. All bubbles burst when risk aversion reaches its irreducible minimum, i.e., credit spreads approaching zero, though analysts’ ability to time the onset of deflation has proved illusive.” {emphasis added}


Some high-yield funds tout that the possible repricing of CRE makes the high-yield safer than equity, but with higher (expected) return.

A point questioned in the accompanying JPM article!
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► Addendum: Forward (Interest & Inflation) Rates
If you only look at a low-inflation era, you might conclude the two are inexorably linked:

Exhibit 1: Comparison of 5-year US Treasury Rates to NCREIF Cap Rates for the Quarterly Periods 1990-2016

Some prefer to use corporate bonds instead. This presents two complications:
1) many corporates are pre-payable, and
2) need to consider differing credit cycles.

Both can be modeled.
Interest Rates vs. Cap Rates: Long-Term Perspective

• The linkage is broken when looking at a longer era:

Exhibit 2: Comparison of 5-year US Treasury Rates to NCREIF Cap Rates for the Quarterly Periods 1979-2016
**Inflation Rates Over the Life of NCREIF Index**

- The Reagan administration is said to have “broken the back” of inflation:

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**Exhibit 3: Annual Inflation Rates for the Period 1978 - 2016**

- **Average = 3.63%**

Sources: Bureau of Labor Statistics and Instructor's calculations
The (Very) Long View on Inflation Rates

- The new era has exhibited both a lower level and less volatility:

Exhibit 4: Annual Inflation Rates for the Period 1914 - 2016

\[ \bar{x}_{1914-1981} = 3.5\% \rightarrow \bar{x}_{1982-2016} = 2.9\% \]

\( \Rightarrow \approx 15\% \text{ reduction in level} \)

\[ \sigma_{1914-1981} = 5.8\% \rightarrow \sigma_{1982-2016} = 1.1\% \]

\( \Rightarrow \approx 80\% \text{ reduction in volatility} \)
Interest Rates v. RE’s Cash-Flow Yields

- Any fair comparison between bonds & real estate must look at cash-flow yields:

Exhibit 5: Comparison of 5-year US Treasury Rates to NCREIF Cap Rates & Cash-Flow Yields for the Quarterly Periods 1979-2016

You can find instances of all four combinations!
Another look at (bonds & real estate) cash-flow yields:

**Exhibit 6: Comparison of 5-year U.S. Treasury Rates to NCREIF Cash-Flow Yields for the Quarterly Periods 1979-2016**

Of course, we should be comparing cash to cash (*i.e.*, Treasury yields *v.* CRE’s (unlevered) cash-flow yield)

The spread reflects:
1. the expected growth in CRE’s future cash flows, less
2. the difference in the expected real returns between CRE and Treasuries.

An Aside: Some investors like to invert this relationship – as it (loosely) suggests positive or negative (cash-flow) leverage.
Conceptual: Interest Rates v. Current Return

• What does the difference ($\delta$) between bond rates ($i/P_0$) and real estate’s cash-flow yields ($CF_1/P_0$) imply?

• Fundamentally, this is a comparison between a fixed-rate, nominal-yield security and a variable-rate, real-yield security.

• More specifically, the difference equals:

  • expected RE’s growth ($g$) in cash flow less
  • the difference in:
    • RE’s expected real return ($r_{RE}$), and
    • Treasury bonds’ expected real return ($r_{TB}$).

\[
\delta = g - (r_{RE} - r_{TB})
\]
Before considering the difference ($\delta$) between bond rates ($i/P_0$) and real estate’s cash-flow yields ($CF_1/P_0$), we need two relationships:

- The nominal ($k$) and real ($r$) returns on any asset are linked by:

$$k = (1 + r)(1 + \rho) - 1$$

- where inflation ($\rho$) is the link between nominal and real returns.

- The total (nominal) return on real estate is also given by:

$$k_{RE} = \frac{CF_1}{P_0} + g$$

- This assumes constant cap rates (an assumption we will revisit).

- Let’s use these relationships to examine $\delta$
Technical: Interest Rates \( v. \) Cash-Flow Yields

• Consider:

\[
\delta = \frac{i}{P_0} - \frac{CF_1}{P_0}
\]

Recall: \( k_{RE} = \frac{CF_1}{P_0} + g \rightarrow \frac{CF_1}{P_0} = k_{RE} - g \)

Rewrite such that \( k = (1+r)(1+\rho) - 1 \)

\[
= \frac{i}{P_0} - (k_{RE} - g)
\]

\[
= (1 + r_{TB})(1 + \rho) - 1 - \left[ (1 + r_{RE})(1 + \rho) - 1 - g \right]
\]

Eliminate & collect terms

\[
\approx g - (r_{RE} - r_{TB})
\]
An Aside: The Path of TIPS Rates

- The real-return requirement on Treasuries is observable via the TIPS market:

TIPS Yields of Varying Maturities
Quarterly Data from 2003 through 2016

TIPS' yields are pro-cyclical.

Note: TIPS were first auctioned in 1997. In 2009, 20-year TIPS were discontinued in favor of 30-year TIPS. Treasury now offers 5-, 10-, and 30-year TIPS.

Source: U.S. Department of the Treasury
As an illustration, assume:

- bond rates \((i/P_0) = 2.0\%\)
- real estate’s cash-flow yields \((CF_1/P_0) = 5.0\%\)

:\. the observed difference \((\delta) = 2.0\% - 5.0\% = <3.0\%>\)

Further assume:

- real estate’s expected cash-flow growth \((g) = 1.5\%\)
- real estate’s real return \((r_{RE}) = 5.0\%\),
- Treasury bond’s real return \((r_{TB}) = 0.5\%\)

:\. the implied difference \((\delta) = 1.5\% - (5.0\% - 0.5\%) = <3.0\%>\)

Also assumes that RE’s growth rate equals the inflation rate \((g = \rho)\)
Illustration: Interest Rates v. Current Return

Illustration of Observed and Implied Spreads:
Interest Rate v. Cash-Flow Yields

Observed Spread: \[ \delta = \frac{i}{P_0} - \frac{CF_1}{P_0} \]

Implied Spread: \[ \delta = g - (r_{RE} - r_{TB}) \]

These are unobservable
Portfolio Tilt Based on Estimates of Unobservables

- One equation with two unknowns produces an “indifference continuum”:

Exhibit 7: Illustration of Trade-Off between Real Estate's Expected Growth Rate $E[g]$; Return Premium Based on Observed Spread Between Treasury Rates and Capitalization Rates

Consider two different forecasts of the expected growth rate of real estate's cash flow.

Assume we want the real return on real estate to exceed the real return on Treasuries by 2.5%.

Buy Real Estate

Sell Real Estate

Portfolio Tilt Based on Estimates of Unobservables
What About Cap-Rate Shifts?

- The prior analyses assume constant cap rates: \( k = \frac{CF_1}{P_0} + g \).
- Let’s consider shifts (\( \nabla \)):

Exhibit 8: Total Annual Return Based Upon Various Capitalization-Rate Shifts and Holding Periods

\[
\nabla = \frac{\text{Ending Cap Rate}}{\text{Beginning Cap Rate}}
\]

\[
\text{Cap Rate Compression:} \quad \frac{NOI_0/P_0}{NOI_N/P_N} > 1
\]

\[
\text{Cap Rate Expansion:} \quad \frac{NOI_0/P_0}{NOI_N/P_N} < 1
\]

Clearly, \( \Delta = f(N, \nabla) \)
Portfolio Tilt Based with Cap-Rate Shifts

Forecasting cap-rate shifts modifies our “indifference continuum”:

Consider two different forecasts of the expected growth rate of real estate's cash flow.

Assume we want the real return on real estate to exceed the real return on Treasuries by 2.5%.

Exhibit 10: Illustration of Trade-Off between Real Estate's Expected Growth Rate vs. Return Premium Based on Observed Spread Between Treasury Rates and Capitalization Rates

Real Estate's Required Real Return in Excess of TIPS' Return ($\phi_{RE}$)

Real Estate's Expected Growth Rate: $E[g]$
## Another Digression: Realized Components of Return

- Expand our earlier return-generating equation: \( k = \frac{\text{NOI}_1}{P_0} \times \bar{b} + \lambda \rho + \Delta + \varepsilon \).
- Substantial differences by property type:

### Exhibit 9: Annualized Components of Return by NPI Property Type for the Period 1978 through 2016

<table>
<thead>
<tr>
<th>Components of Return:</th>
<th>Total NPI</th>
<th>Apartment</th>
<th>Office</th>
<th>Industrial</th>
<th>Retail</th>
</tr>
</thead>
<tbody>
<tr>
<td>(39 Years)</td>
<td>(39 Years)</td>
<td>(39 Years)</td>
<td>(39 Years)</td>
<td>(39 Years)</td>
<td>(39 Years)</td>
</tr>
<tr>
<td>Initial Income Yield ( (\text{NOI}_1/P_0) )</td>
<td>8.51%</td>
<td>8.46%</td>
<td>8.92%</td>
<td>8.53%</td>
<td>7.74%</td>
</tr>
<tr>
<td>( x ) Average Dividend Pay-out Ratio ( (\bar{b}) )</td>
<td>67.1%</td>
<td>80.4%</td>
<td>64.0%</td>
<td>61.8%</td>
<td>68.5%</td>
</tr>
<tr>
<td>= Dividend Yield ( (CF_1/P_0) )</td>
<td>5.71%</td>
<td>2.84%</td>
<td>5.71%</td>
<td>2.92%</td>
<td>5.30%</td>
</tr>
<tr>
<td>+ Earnings Growth ( (g) )</td>
<td>2.42%</td>
<td>2.84%</td>
<td>2.92%</td>
<td>1.42%</td>
<td>2.98%</td>
</tr>
<tr>
<td>= Fundamental Return ( (CF_1/P_0 + g) )</td>
<td>8.13%</td>
<td>9.64%</td>
<td>7.99%</td>
<td>6.70%</td>
<td>8.28%</td>
</tr>
<tr>
<td>+ Shift in Capitalization Rates ( (\Delta) )</td>
<td>0.54%</td>
<td>0.43%</td>
<td>0.83%</td>
<td>0.51%</td>
<td>0.41%</td>
</tr>
<tr>
<td>+ Other Effects</td>
<td>0.62%</td>
<td>0.48%</td>
<td>0.89%</td>
<td>0.50%</td>
<td>1.08%</td>
</tr>
<tr>
<td>= NCREIF Total Return – Nominal ( (k) )</td>
<td>9.29%</td>
<td>10.55%</td>
<td>9.72%</td>
<td>7.71%</td>
<td>9.77%</td>
</tr>
<tr>
<td>NCREIF Total Return – Real ( (r) )</td>
<td>5.60%</td>
<td>6.83%</td>
<td>6.02%</td>
<td>4.08%</td>
<td>6.07%</td>
</tr>
</tbody>
</table>

### Inflationary Characteristics:
- Inflation \( (\rho) \) | 69.5% | 81.5% | 65.5% | 40.8% | 85.4% | 65.3% |
- NOI Inflation Pass-Thru Rate \( (\lambda) \) | 3.49% | 3.49% | 3.49% | 3.49% | 3.49% | 3.49% |

### Pricing Characteristics:
- Beginning Capitalization Rate \( (NOI_0/P_0) \) | 8.19% | 7.98% | 8.71% | 8.35% | 7.42% | 8.84% |
- Ending Capitalization Rate \( (NOI_N/P_N) \) | 4.59% | 4.48% | 3.98% | 4.96% | 4.90% | 5.50% |

### Risk Measure:
- Annual Volatility \( (\sigma) \) | 7.62% | 7.80% | 11.45% | 9.08% | 7.38% | 8.82% |

**Note:** Nearly 90% of long-run returns determined by the Fundamental Return.
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The Path of Values & Cap Rates

- High prices and low cap rates have many of us apprehensive:

Exhibit 11: NCREIF Index - Market Values, Rescaled NOI and Capitalization Rates Based on a $100 Investment for the Period 1978 through 2016

Another Aside: It seems that sluggish NOI growth is an under-reported part of the real estate story.
• Examining the evolving mean, $\overline{x}$, and volatility, $\sigma$, of capitalization rates:

Difficult to avoid the conclusion that current capitalization rates (like those before the GFC) are historically low.
• Of course, we rationalize cap rates based on interest rates:

Historical Path of Treasury Bond Interest Rates
1-, 10- and 30-year Maturities for the Period 1954 through 2016

Note: The 30-year bond series begins in 1977, but was discontinued for four years (2002-2006).
What Is the Appropriate Cash-Flow Yield?

- **WANT:** Recall the link between the nominal ($k$) and real ($r$) returns:

$$k_{RE} = (1 + r_{RE})(1 + \rho) - 1$$

- **HOW:** Ignoring cap-rate shifts ($\nabla = 1.0$), total return is also given by:

$$k_{RE} = \frac{CF_1}{P_0} + g = \frac{CF_1}{P_0} + \lambda \rho \quad \{ \text{Recall: } g = \lambda \rho \}$$

Let’s set these equations to one another (and solve for $CF_1/P_0$):

\[
\begin{align*}
(1 + r_{RE})(1 + \rho) - 1 &= \frac{CF_1}{P_0} + \lambda \rho \\
\frac{CF_1}{P_0} &= r_{RE}(1 + \rho) + \rho(1 - \lambda)
\end{align*}
\]

What We Want

- Real return, grossed up for inflation
- Uncompensated portion of inflation

How We Will Get It

- Eliminate and collect terms
Variations on the Appropriate Cash-Flow Yield

• Recall the appropriate cash-flow yield:

\[
\frac{CF_1}{P_0} = r_{RE} (1 + \rho) + \rho (1 - \lambda)
\]

• Consider the first of two cases:

1. If markets are in equilibrium (\( \lambda = 1.0 \Rightarrow g = \rho \)), then:

\[
\frac{CF_0 (1 + \rho)}{P_0} = r_{RE} (1 + \rho) + \rho (1 - \lambda)
\]

{ Recall: \( CF_1 = CF_0 (1 + \lambda \rho) \) }

Eliminate and collect terms

\[
\frac{CF_0}{P_0} = r_{RE}
\]

• So, if markets are in equilibrium, then real estate’s real return is its trailing cash-flow yield (\( CF_0/P_0 \)), \textit{irrespective} of the inflation rate!
Variations on the Appropriate Cash-Flow Yield

• Again, recall the appropriate cash-flow yield:

\[
\frac{CF_1}{P_0} = r_{RE} (1 + \rho) + \rho (1 - \lambda)
\]

• Consider the second of two cases:

2. Markets generally talk in terms of cap rates, so let’s restate:

\[
\frac{CF_1}{P_0} = \frac{NOI_1(\bar{b})}{P_0} = r_{RE} (1 + \rho) + \rho (1 - \lambda)
\]

\[
\frac{NOI_1}{P_0} = \frac{r_{RE} (1 + \rho) + \rho (1 - \lambda)}{\bar{b}}
\]

{ Recall: \[ NOI_1 \ast \bar{b} = CF_1 \} \]

• If history is a fair guide to the future, then multiply the appropriate cash-flow yield by 3/2 (i.e., \( \bar{b} \approx 2/3 \)) in order to find the appropriate capitalization rate.
Likely Real Returns in the Current Environment

• Recall the appropriate capitalization rate and solve for \( r_{RE} \):

\[
\frac{NOI_1(b)}{P_0} = \frac{r_{RE} (1 + \rho) + \rho (1 - \lambda)}{b}
\]

\[
r_{RE} = \frac{\frac{NOI_1 b}{P_0} - \rho (1 - \lambda)}{(1 + \rho)}
\]

• Consider some plausible parameterization:

\[
r_{RE} = \frac{(4.5\%) (67\%) - .02 (1 - .7)}{(1 + .02)} \approx 2.5\%
\]

Recall: \( \bar{r}_{RE} \approx 5.6\% \)

However, today’s 5-year TIPS \( \approx 0.2\% \)
• Some investors naively assume:
  • Interest Rates ↑ → Asset Prices ↓

• However, a change in interest rates = \( f(\bullet) \):
  • a change in inflation (\( \rho \)) expectations, and/or
  • a change in the real return (\( r \)) requirement.

• These two factors can have very different impacts on asset values:
  • Inflation ↑ → Interest Rates ↑ → Asset Prices ↑
  • Real Return ↑ → Interest Rates ↑ → Asset Prices ↓
Valuations & Interest Rates: Technical

• Restate earlier equation(s) in terms of price \( P_0 \):

\[
P_0 = \frac{CF_0 (1 + \lambda \rho)}{(1 + r_{RE}) (1 + \rho) - 1 - \lambda \rho}
\]

• Take the derivative when in equilibrium and when not:

<table>
<thead>
<tr>
<th>When ( \lambda = 1 )</th>
<th>When ( \lambda \neq 1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is our earlier result; prices are unaffected. [ \frac{\partial P_0}{\partial \rho} = 0 ]</td>
<td>[ \frac{\partial P_0}{\partial \rho} = \frac{-CF_0 (1 + r_{RE})(1 - \lambda)}{[(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho]^2} ]</td>
</tr>
<tr>
<td>This is also our earlier result; prices are negatively affected by an increase in real return. [ \frac{\partial P_0}{\partial r_{RE}} = -CF_0 ]</td>
<td>[ \frac{\partial P_0}{\partial r_{RE}} = \frac{-CF_0 (1 + \rho)(1 + \lambda \rho)}{[(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho]^2} ]</td>
</tr>
<tr>
<td>N.A.</td>
<td>[ \frac{\partial P_0}{\partial \lambda} = \frac{CF_0 (1 + r_{RE})(1 + \rho) \rho}{[(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho]^2} ]</td>
</tr>
</tbody>
</table>

When markets are not in equilibrium (and \( \lambda < 1 \)), property values fall when inflation (\( \rho \)) increases.

The effect is worse when markets are not in equilibrium (and \( \lambda < 1 \)).

Property values rise (fall) as \( \lambda \) improves (worsens).
Importance of TIPS Rates: Historical Path

- Given pro-cyclical TIPS yields, will we see those rates move substantially higher?

Exhibit 13: TIPS Yields of 5-Year Maturities
Quarterly Data from 2003 through 2016

The historical average 5-year TIPS yield is ~0.6%

Given the 2007-08 financial crisis, the historical average may not be reflective of the equilibrium level.
Schizophrenic Relationship with TIPS Rates?

- No statistically reliable relationship between RE’s real yield and TIPS rates:

Exhibit 14: A Comparison of Realized Real Returns on U.S. Treasury and the NCREIF Property Index for Various Time Periods

<table>
<thead>
<tr>
<th></th>
<th>1978-2016 (Entire History)</th>
<th>1987-2006 (Low Inflation &amp; Pre-Crisis)</th>
<th>2003-2016 (TIPS History)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCREIF Property Index</td>
<td>5.79%</td>
<td>5.37%</td>
<td>7.36%</td>
</tr>
<tr>
<td>U.S. Treasury Bonds</td>
<td>5.70%</td>
<td>5.86%</td>
<td>4.53%</td>
</tr>
<tr>
<td>Mean Difference ($\phi_{RE}$)</td>
<td>0.09%</td>
<td>-0.49%</td>
<td>2.83%</td>
</tr>
<tr>
<td>Volatility of Difference</td>
<td>14.70%</td>
<td>12.85%</td>
<td>14.08%</td>
</tr>
<tr>
<td>Standard Error</td>
<td>2.35%</td>
<td>2.87%</td>
<td>3.76%</td>
</tr>
</tbody>
</table>

None of these differences are statistically significant.

\[ \therefore \] History is not much of a guide and we are left with trying to determine \textit{ex ante} as to the appropriate spread (perhaps the most-recent period is the best indication).

Recall that these spreads ignores fees and illiquidity of CRE.
Asset Bubbles ← Who Cares?

- If you are a long-term, low-levered CRE investor, these deviations matter little.

- So, these asset bubbles matter more to:
  - Long-term, high-levered investors – particularly those with short-term debt maturities (e.g., Macklowe’s EOP | Manhattan*) and/or poorly laddered maturities (e.g., pre-crash GGP v. SPG).
  - Short-term investors (e.g., value-add & opp funds, developers, etc.).
  - High-leverage, high-yield lenders – particularly those with levered balance sheets (e.g., Blackstone mortgage REIT, Colony Capital debt funds, etc.).
  - Government agencies (e.g., Fannie, Freddie, HUD, Fed, etc.):
    - with exposure to high-leverage borrowers, and
    - who become the “lenders of last resort” in a downturn.

* Aggravated by $1 billion recourse bridge loan.
Concluding Remarks

- We have looked at two key aspects of real estate pricing:
- First, the spread between interest rates and cap rates was examined:
  - The former represents a riskless, nominal-yield, fixed-rate security,
  - While the latter represents a risky, real-yield, real-yield security.
  - The difference represents the market’s consensus view on: \( \delta = g - (r_{RE} - r_{TB}) \)
  - Investors tilt their portfolios, depending on how their views differs from the consensus.
- Second, the appropriate cap rate depends on balancing what and how:
  - When markets are in equilibrium (\( \lambda = 1 \)), changes in inflation (\( \rho \)) have no effect.
  - Regardless of market equilibrium, changes in the real return (\( r_{RE} \)) have a large effect.
- The impact (\( \Delta \)) of cap-rate shifts (\( \nabla \)) can be approximated by:
  \[
  \Delta = f(N, \nabla) \approx \sqrt[N]{\frac{1}{\nabla}} - 1
  \]
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► Addendum: Forward (Interest & Inflation) Rates
Today’s Yield Curve & Future Interest Rates

• The “expectations theory” of future interest rates:

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>2.0%</td>
</tr>
<tr>
<td>2 years</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Then:

The implied one-year interest rate in one year is expected to be \( \approx 3.0\% \)

• That is, bond investors are assumed to be indifferent between:

\[
(1 + .02) \ (1 + x) = (1 + .025)^2 \quad \rightarrow \quad x \approx .03
\]

Holding the 1-year security and “rolling over” to 1-year security in the second year

Holding the 2-year security to maturity
Consider one more period:

\[
(1 + 0.025)^2 \times (1 + y) = (1 + 0.0275)^3
\]

\[\Rightarrow y \approx 0.0325\]

That is, bond investors are assumed to be indifferent between:

- Holding the 2-year security and “rolling over” to 1-year security in the third year
- Holding the 3-year security to maturity

Then:
- The implied one-year interest rate in two years is expected to be \(\sim 3.25\%\)

This approach can be extended to the entirety of today’s yield curve.
Today’s Yield Curve

Yield Curve for U.S. Treasury Rates as of October 27, 2017

An upward-sloping yield curve implies a rise in future interest rates

Sources: US Department of the Treasury and Instructor's calculations.
Market’s View of Expected Future One-Year Treasury Rates

The consensus view suggests that the 1-year Treasury rate rises, by $\approx 145$ bps, to $\approx 2.80\%$.
The consensus view suggests that the 5-year Treasury rate rises, by \( \approx 80 \) bps, to \( \approx 2.85\% \).
The consensus view suggests that the 10-year Treasury rate rises, by $\approx 50$ bps, to $\approx 2.95%$. 

**Current & Implied Forward 10-Year Treasury Rates as of October 27, 2017**
Imputed Inflation Rates
Based Upon Current Treasury Bonds & TIPS Yields

The consensus view suggests that the inflation rates rise to ≈1.9%

Sources: U.S. Department of the Treasury [Rates as of October 27, 2017] and Instructor’s calculations.
Market’s View of Expected Future One-Year TIPS Rates

Current and Implied Forward 1-Year TIPS Rates as of October 27, 2017

The consensus view suggests that the 1-year TIPS rate rises, by \( \approx 110 \text{ bps} \), to \( \approx 0.85\% \)
The consensus view suggests that the 5-year Treasury rate rises, by ≈ 65 bps, to ≈ 0.90%
The consensus view suggests that the 10-year Treasury rate rises, by ≈ 45 bps, to ≈ 1.00%
Today’s Yield Curve & Future Cap Rates

What if the 5-years TIPS’ rate increases by 65 basis point?

Let’s assume that cap rates increase by 75 basis points.

Recall: \[ P_0 = \frac{CF_0 (1 + \lambda \rho)}{(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho} \]

This is our earlier restatement of the cash-flow yield

If and when that repricing occurs, real estate values will fall by 20%!

However: 1) the impact is always difficult to time, and 2) the adverse impact on total returns is a \( f \)(holding period):

<table>
<thead>
<tr>
<th>Holding Period</th>
<th>Cap-Rate Shift Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-20.00%</td>
</tr>
<tr>
<td>2</td>
<td>-10.56%</td>
</tr>
<tr>
<td>3</td>
<td>-7.17%</td>
</tr>
<tr>
<td>4</td>
<td>-5.43%</td>
</tr>
<tr>
<td>5</td>
<td>-4.36%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>10</td>
<td>-2.21%</td>
</tr>
</tbody>
</table>
Caveat: Market’s View Is Often Wrong

This “hairy” chart illustrates the divergence between actual and expected.
A Similar Perspective on Market’s Omnipotence

This chart also illustrates the divergence between actual and expected. Market-predicted LIBOR rate exceeded the actual by 73 bps, on average.
A Similar Perspective: Long-Term (10-Year) Treasuries

Cautionary Note

• If you are really good at forecasting future interest rates:
  – Get out of the real estate business!
  – Get into the bond-trading business:
    ➢ sit in your pajamas,
    ➢ trade from home for < 1 hour/day, and
    ➢ hit the beach (golf course, bike trails, etc.) the rest of your day!